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CROPPING and CONSERVATION

Demonstrations and Applied Research Opportunities

November 1989

Alberta
AGRICULTURE

CROPPING
and
CONSERVATION

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and
Applied Research
Opportunities

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CROPPING AND CONSERVATION

DEMONSTRATIONS AND APPLIED RESEARCH

SUGGESTED OPPORTUNITIES

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PURPOSE:

The purpose of this publication is to provide Alberta Agriculture staff, agricultural fieldmen, service board members and others with ideas for applied research projects, demonstrations and information needs to meet the challenge of assisting farmers in their quest for information on crop production in the 1990's.

BACKGROUND:

Productivity and economics have been the driving force behind our management of our land and water resources. There is now an increasing demand and an awareness to assess the effects of our production practices on these resources. Whether we call it a conservation ethic, sustainable agriculture, responsible agriculture or economically and environmentally sound agricultural production systems, there is need to assess our present practices in light of this concern. Farmers are faced with a continuum of decisions prior, during and after growing a crop, each of these depending on a range of factors. We now must add one more dimension, that of the conservation of the soil and water resources of the farm. The question now is "if I do this, what impact will it have on the erosion or deterioration of my soil and water resource?" Any changes must have minimum impact on the economics of producing crops.

THE PROBLEM:

An increased awareness has farmers asking how they can revise their cropping systems to reduce soil degradation. We must be aware that sound agriculture and crop management practices must not only sustain but improve our basic soil resource. Many soils are now in better condition than they were 20 years ago. Yields of the same variety of barley without fertilizer in central Alberta have now increased to 50 bu/ac from 31 bu/ac in 1972.

The innovative farmer has continued to try new things, testing them first, then adopting them on the basis of success. Most say they will not be panicked into change, but will gradually adopt new methods to reduce risk of income loss and over capitalization given sufficient time to assess new techniques.

It would appear farmers are seeking definitive answers on a range of questions relating to tillage, planting, pest control, (weed, insect and disease), crop varieties, rotations, fertilizer use and ways of managing crop residues, all with the intention of continuing to manage their basic soil and water resources in a responsible manner.

NEEDS:

i) Farmer - Requires information, some general and some very specific, on alternatives adaptable to his farm which will reduce erosion, salinity and/or organic matter depletion and enhance crop production. In some instances he will want to see these alternatives demonstrated in his district before he is prepared to test or adopt.

ii) Front Line Divisions - To provide alternatives for the many different agro-ecological areas of the province. If information is not available, staff must carry out research or see what others do to obtain answers. In some instances it may mean revising our present recommendations, e.g., less tillage, less fallow, etc.

iii) Department - In order to accomplish the goal of less soil degradation, programs will need to be developed to provide farmers with reliable information with little delay. Unfortunately some answers may take 5-10 years to develop as the soil system reaches a new equilibrium with a newly introduced cropping system. As one of the goals is to adopt systems which have minimal adverse effect on the environment over the long term, so too must systems be monitored for this time period.

A co-operative spirit must be developed so that all involved are part of a team.

ISSUES IN CONSERVATION FARMING

As farmers consider a more conservation approach to their farming practices, they have difficulty in several areas due to a lack of information, or in being able to adopt known technology to current situations without incurring extra expense or reducing yields. The major areas of concern which face farmers can be categorized as:

1) Handling Crop Residue
2) Pest Control with Reduced Tillage
3) Soil Fertility
4) Soil Structure Maintenance and Improvement
5) Managing Spring Moisture
6) Effective Snow Management

Within each of the following sections, the categories considered will be

A) identification of problem
B) goals
C) information available
D) suggested field demonstrations
E) suggested applied research projects
F) information needs

HANDLING CROP RESIDUES

A. **Problem** - The handling of crop residues while preparing a seed bed with little or no soil disturbance is a major problem. The usual way of dealing with extra residue is "another cultivation pass" which is contrary to the "conservation ethic". Residues, inadequately managed will result in one or more of the following:

1) a poor seed bed
2) varying seed depth
3) lower soil temperatures
4) poor herbicide incorporation
5) little snow retention
6) a tie-up of nitrogen for residue decomposition
7) poor machine performance due to plugging.
8) increased soil erosion

All of the above may result in poor germination, poor emergence or poor seedling establishment and can ultimately reduce yield.

B. **Goals**

- To improve handling straw and chaff from the combine.
- To determine value of straw in preventing soil degradation.
- Leaving standing stubble to trap snow and prevent winter soil erosion.
- Reducing working depth and speed of implements that bury stubble.
- The use of the proper implement in the fall to retain residue cover.
- Replacing the straw baled for livestock feed with manure from the livestock operation.
- Leaving the straw, rather than removing, on certain fields or portions of fields that are highly erodable.

- Alternatives to adding crop residues where amounts are unacceptably low.
- To change farmer attitude that "black" fallow is beautiful.

C. Information Available

Conservation Tillage - Agdex 516-3
Wind erosion and its control - Agdex 572-2
Conservation Tillage Manual (In print, April, 1990)

D. Suggested Field Demonstrations

1) Direct or minimum pre-tillage planting with hoe drills and airseeders.

Supply or demonstrate the use of planters which will allow planting and fertilizer placement with minimum or no tillage. This method allows crop residue and stubble to be left on the field over winter and during a summerfallow period.

The airseeder, equipped with suitable ground openers, is the most likely machine to be accepted by, and practical for farmers. Demonstrations would encourage farmers to spray winter annual weeds and leave crop residues for direct planting in the spring. Twenty acre trials may be compared with adjacent land treated using in the farmer's present method.

2) Fall versus no fall tillage

No fall tillage is particularly important to soils with high erosion potential and where reserve soil moisture is low. The demo will compare untilled land to fall operations which bury crop residues.

Visible wind and water erosion measurement of soil moisture and crop yield may indicate success. Projects may be modified by not tilling parts of a field such as knolls, slopes, hill tops, or sandy areas.

3) Fall tillage with and without harrows

In the event a farmer must complete some operations in the fall, minimum loss of stubble is desired. It is often believed the soil must be harrowed "closed" to maintain moisture and smooth the field for subsequent operations. The advantage of snow held on the field is lost because less snow is trapped. An unharrowed fall tilled field will also reduce wind and water erosion by leaving a rougher surface with greater water infiltration. This type of surface may also carry equipment earlier in the spring.

A demo may compare the soil moisture gain from a deeper snow pack as a result of a rougher surface with some stubble still standing, to that which is harrowed smooth.

4) Reduced tillage cropping

A comparative trial may test four or five levels of tillage. This will show the farmer an example of what he does now compared to reduced tillage alternatives. The test should include a zero tillage treatment, a single spring tillage, a spring and fall tillage, and a treatment similar to what the co-operating farmer does. If the test is conducted at several sites, data collected could be quite meaningful to area farmers.

5) Reduced tillage summerfallow

A relatively easy demo can show the merits of chemical fallow, chem-till fallow and tillage fallow.
Items to consider for this demonstration are:

- don't start in a known weed problem.
- fall or spring 2-4-D a must
- spray weeds at early growth stage.
- farmer commitment to full year time span (no Treflan)
- till at best time for weed control
- conduct as if large field
- larger plots (5 acres)

6) Tillage equipment for reduced soil disturbance on disturbance on summerfallow

Blades, rod-weeders, and low crown chisel plow sweeps may be demonstrated as a method of maintaining greater amounts of surface residue while meeting the objectives of summerfallow. The measure of good success is the obvious control of weed growth. The demo should encourage producers to leave the residues on the surface through the second winter as well. There is an unfortunate desire to blacken the surface in August to incorporate a herbicide.

7) Alternatives to tillage/chemicals for weed control

Clipping of weeds in an advanced stage with a sickle bar (swather) or mower is likely to be the most effective approach. Often on summerfallow, weeds occur in patches coverily part of a field. For least cost and best soil conservation, clipping is an alternative.

This demo could be set up on an existing tillage or summerfallow project.

8) Straw mulching in lieu of tillage

A drawback to reduced tillage is the limitation of both tillage and planting equipment to function properly during the second pass through heavy straw residue. If the residue is finely mulched most existing planters will operate directly into spring soil conditions. Demonstrations may be set up where farmers do not till in the fall and wish to plant in one operation in the spring. Prior to planting a rotary mower can be used to mulch the surface residue so it will not interfere with the planting operation. The practice is used by a few farmers in Alberta.

This demo may be easy to conduct as mulches exist in many districts and only a tractor and operator are needed. There are a owing number of farmers who have invested in airseeders or hoe drills. They would be interested in this concept.

E. Suggested Applied Research Projects

An investigation of alternate types of harrows for mulching straw.

F. Information Needs

The assembling of information for distribution to farmers to address the above concerns. One approach may be a series of "Fact Sheets". Each "Fact Sheet" would deal with a separate topic but all combining as one "overall" package dealing with "Handling Crop Residues". The package of information would deal with the time span from cutting the crop through to planting the next spring. The information must deal with not only "Why" but also "How To". Many producers know why certain things need to be done but have difficulty in adopting conservation principles. The fact sheets should deal with:

1) Cutting the previous crop - straw deflectors, various stubble heights (how often, distance apart, height etc.).

2) Combining the crop - proper spreading of chaff and straw, value of straw in preventing soil degradation ($ lost in top soil erosion), replacing baled straw with manure, or not baling straw on eroded or erodable fields.

3) Fall Work - how to effectively incorporate herbicides and fertilizer and prepare a seedbed while maintaining standing stubble. Address the controversy concerning fall work and moisture loss versus retaining stubble for collecting

moisture. Often fall cultivation involves implements with mounted harrows so must specifically address harrowing for smoothness and sealing soil moisture versus keeping stubble standing for moisture conservation.

4) Spring Work - Address how to prepare the seed bed and handling the residue without losing the accumulated winter moisture.

- Address methods to warm soil, start and or kill weeds, mellow soil, properly incorporate herbicides and pack for seeding without losing moisture.

- Investigate the possibility of using flail/flail type mowers as a means of handling excess standing stubble or other excess residue preliminary to seed bed preparations.

PEST CONTROL WITH REDUCED TILLAGE

The protection of crops from pest injury may be achieved by preventing the problem pest from becoming established or controlling its impact after establishment.

Traditionally, sanitation has been a key method in the control of plant diseases. This was accomplished by the burning of the straw containing the disease or burying it by cultivation to prevent its growth. In addition, crop rotations and use of tolerant varieties is practiced to insure that disease organisms do not economically damage crops. Similar concepts apply to insects.

Preventative techniques of weed control such as weed free seed, spot treatment, hand rogueing, etc. do not readily lend themselves to demonstration.

Since the control of perennial weeds is based on the premise of root starvation, tillage, herbicides, biological organisms or a combination of any two or more, ample opportunity for control demonstrations exist.

Pest Control operations are based on an indepth knowledge of the life cycle of the pest and the conditions which allow its population to flourish or recede. The practice of conservation farming is by design changing soil conditions under which we have learned to control many pests in the past. Some of these practices may be enhancing pest control, others contributing to the build up of pest problems.

The challenge is to allow these control measures to operate within the constraints of the conservation objectives.

A. **Problem** -

  1) Weeds - How to adequately replace tillage or combine tillage and chemicals as an economic means of weed control.

2) Insects & Diseases - preventing the build up of insects and disease under reduced tillage programs. Leaving more residue cover creates a better environment for diseases and insects to survive and thrive. This coupled with more unicropping systems and the increased susceptibility of most of the new varieties to disease creates a potentially "explosive" situation for producers.

B. **Goal** - To make producers more aware of the potential for yield reduction due to possible increase in pests in crops, and the measures farmers might take to counter balance this potential.

C. **Information Available**

Guide to Crop Protection in Alberta, Part II, Non-Chemical Control, Agdex 606-2
Herbicide Carryover, Agdex 609-3
Guide to Crop Protection in Alberta, Part I, Agdex 620 - 3
Natural Enemies of Field Crop Insect Pests in Alberta, Agdex 622-6

D. **Suggested Field Demonstrations**

1) Yield effect of minimum till on continuous barley vs ploughing or deep cultivation.

2) Yield effect of minimum till on a canola, wheat, barley rotation vs continuous barley.

3) Yield effect of minimum till on a canola, wheat, barley rotation vs ploughing or deep cultivation on the same rotation.

Yields of these demonstrations would be most affected by disease levels influenced by crop residues.

E. Suggested Applied Research Projects

1) Changing disease spectrums under minimum tillage systems vs deep cultivation for (1) Cereals, (2) Oilseeds.

2) Development of techniques to manage foliar diseases of cereals under a minimum tillage system.

3) Comparison of the value of stubble burning vs other management techniques on management of specific pests.

4) A comparison of root maggot pupae survival under conservation tillage vs fall tillage practices.

5) A comparison of the survivability of flea beetles and thrips on fields with various stubble heights.

6) Assess the impact of conservation practices on the incidence and economic impact of insects and native predators. Example insects to be considered:
    - Hessian fly
    - Thrips
    - Canola root maggot
    - Wheat stem maggot
    - Cutworms
    - Grasshoppers

    Example: Predators to be considered:
    - Spiders
    - Ground beetles

7) Development and/or adaptation of perennial weed control strategies for reduced/conservation tillage systems.

   - Control of toadflax in a continuous cropping and/or cereal - fallow rotations with specific emphasis on sites subject to weed erosion.

   - Curbing the incidence and spread of spreading dogbane in minimum tilled lands.

   - Managing scentless chamomile under minimum till and forage rotational systems.

   - Other locally significant perennials ie. wild rose, quackgrass, perennial sow thistle, etc.

8) Economical and effective chem-fallow alternatives for different weed regimes.

9) Weed management on legume plowdown crops.

10) Weevil management in sweet clover plowdown.

F. **Information Needs** - The development of "Fact Sheets" or other forms of information for distribution to farmers on:

1) The potential for increased pest problems associated with stubble farming and how problems can be avoided by the use of:
   a) different varieties
   b) more species
   c) green manures
   d) fungicides.

A lot of information is currently available but it is not written from the conservation viewpoint. The recommendations often involve the use of increased tillage and the burying of stubble.

2) Weed control and reduced tillage.
Several topics of importance include:

   a) Fall spraying for perennials and winter annuals before the first killing frost versus tillage.
   b) Incorporating herbicides while retaining stubble and soils structure.
   c) Herbicide resistance and tolerance (herbicide rotations).
   d) Herbicide use from the conservation perspective, i.e., better tillage and herbicide combinations/systems.

3) Economic losses in crops due to diseases, weeds, insects.
The above items should be addressed in the "How to" perspective.

SOIL FERTILITY

Nitrogen fertilizer is soluble and toxic to most seedlings. The present recommended method of application is known as "deep banding". Placement below seed depth in dry soil areas and banded in moist/wet soils increases utilization up to 40% over the broadcast and incorporation method. As the deep banding operation is similar to a tillage operation, crop residues can be buried. Combined tillage and fertilizer application operations will reduce crop residue loss.

The use of spoke and pulse injection equipment is presently at the research and developmental stage. Early indications are that fertilizer could be injected into large quantities of crop residue.

Applied research is required to test the effectiveness of the equipment. The present limitation is availability of suitable injection equipment. Should present research prove the method feasible, equipment may be available within the next few years.

Another non-surface disturbing application method is called "pulse" bander and is presently being developed for testing.

A. **Problem** - Farmers face difficulty in adequately placing larger amounts of fertilizer with minimal soil disturbance.

B. **Goal** - Extension activities to inform producers of the latest information on fertilizer use and placement and retaining the principles of achieving high production and good conservation practices.

C. Information Available

Alberta Fertilizer Guide, Agdex 541-1
Fertilizer Application Equipment, Agdex 542-6
Applying Fertilizers Effectively Agdex 542-7

D. Suggested Field Demonstrations

- demonstrate new fertilization application equipment and methods as they become available.

E. Suggested Applied Research

Some useful applied research projects may include:

1) Proper amounts and placement of fertilizer with minimal soil disturbance (shank design, high pressure (pulse) injection, spoke wheel injection, nesting of fertilizer, rates required under reduced tillage).

2) Timing of application (before, during and after seeding).

3) Effect of crop disease and fertility, e.g., black spot of canola with sulphur.

4) Control of crop disease e.g., Chloride effect (KCl).

F. Information Needs

- Producers require answers to help achieve proper fertilization and placement for good yields while conserving soil moisture and maintaining soil tilth. This information must deal with the "How to" approach. This information may be extended through the development of factsheets, videos, pamphlets, and publications.

SOIL STRUCTURE MAINTENANCE & IMPROVEMENT

A. **Problem** - Producers indicate difficulty in identifying how green manure, cover crops, and residues can be economically used in crop rotations to improve soil structure and reduce costs.

B. **Goal** - To make producers aware of all the current information and techniques associated with the use of cover crops, green manure, and crop residues; and the incorporation of these into cereal and oilseed production programs.

C. **Information Available**

1) "Soil Improvement with Legumes", Saskatchewan Agriculture.

D. **Suggested Field Demonstrations**

1) Demonstrate the use of various crops as potential green manures and cover crops.
2) Demonstrate the use of cover crops for preventing wind and water erosion, trapping snow, and replacing organic matter during a summerfallow year.
3) Demonstrate how crop residues can be used to prevent erosion in low, erodable areas.
4) Demonstrate the value of crop residues and a soil improvement technique on erodable or eroded knolls, hills, etc.

E. **Suggested Applied Research Projects** - Additional information is needed on the use of green manure crops in terms of:

1) How to incorporate green manure crops while retaining soil moisture and a soil surface mulch (implements to use, frequency of operation, sequence of crops after using green manures).

2) Species selection.

3) Economics of green manuring (Can I afford it?),
   - Value of crop in terms of preventing soil degradation value to subsequent crop.

4) Various annual crops as an alternative to bare summerfallow.

Additional information is needed on the use of cover crops in terms of:

1) species selection (organic matter added as well as physical growth).
2) value of cover crops from a soil stabilizing aspect.

F. Information Needs

Many of the "How To Do" aspects of green manuring are not addressed. Development of extension materials to answer these concerns is a priority.

MANAGING SPRING MOISTURE

A. **Problem** - To retain as much moisture as possible that was accumulated the previous summer and winter. Often moisture is lost in the spring from excess cultivation due to:

- the incorporation of herbicides
- improper implement selection combined with speed, depth, etc.
- eliminating excess residue with cultivation equipment.

B. **Goal** - To make producers aware of the value of this accumulated spring moisture and the best ways to retain this moisture while preparing a proper seedbed for the next crop.

C. Information Available

Soil Moisture Management, Agdex 510-1
On-Farm Water Management Manual (In print, June 1990).

D. Suggested Field Demonstrations

- Value of shelterbelts and native tree bluffs in retaining moisture.
- Value of retaining low recharge areas in native vegetation for water storage (consolidation versus drainage).
- Value of sloughs as a water gathering and holding method on the farm.

E. Suggested Applied Research Projects

Different and innovative approaches to handling stubble.
Speed, depth and type of implement versus moisture loss.

The working of soil
  - to warm soil
  - starting/killing weeds
  - mellowing soil

Seed bed preparation while retaining soil moisture (address both summerfallow and stubble).

F. **Information Needs** - To assemble information for distribution to farmers to address the above concerns. An overall package made up of individual "Fact Sheets", addressing the "Needs". Again, the main theme should address the "How to" question more than the "Why".

EFFECTIVE SNOW MANAGEMENT

A. **Problem** - Producers face difficulty in retaining as much snow as possible on fields where it will be converted into useful moisture for the following year. A conflict persists between retaining stubble for snow trapping versus applying fall herbicides and fertilizers.

B. **Goal** - To provide up to date and pertinent information to producers on improved method of snow management to improve soil moisture, reduce erosion, and increase production.

C. **Information Available**

Soil Moisture Management, Agdex 510-1

D. **Suggested Field Demonstrations**

- Demonstrate attachments to plant non-competitive strips for snow trapping, windrower attachments for tall stubble strips, and alternating stubble heights.
- Several devices and methods exist to assist in holding more snow on the field. Farmers may only adopt these after having seen them in place on neighboring demonstrations or in use by other farmers. It is only necessary to find interested farmer co-operators and assist them in setting up and operating the equipment. Some potential demos may include:

  a) use of swather deflectors

b) use of grass strips (varieties, width of strip, distance between strips under various Alberta Conditions).

c) field shelterbelts

E. **Suggested Applied Research**

- Value of sloughs, shelterbelts, native tree bluffs in retaining soil moisture.
- Value of retaining low recharge areas in native vegetation for water storage (consolidation versus drainage).

F. **Information Needs** - Develop information that is available for distribution to address the above concerns.

FIELD SHELTERBELTS DEMONSTRATIONS

Results from other areas have proven that shelterbelts are a permanent solution for preventing wind erosion. Shelterbelts take up some land, but the increase in crop yield more than compensates for this loss. Cultivation practices may be able to be changed without a loss of efficiency. The slow drying area north of the shelterbelts is a strip that is about as wide as the shelterbelt is tall and may be left as headland.

A. **Problem** - Attitudes about shelterbelts, such as
   - shelterbelts are obsolete
   - shelterbelts waste productive land
   - shelterbelts interfere with cultivation practices
   - crops are slower drying on north side of shelterbelt

B. **Goal** - To demonstrate the value of field shelterbelts for
   - reducing soil movement
   - increasing crop yield

C. **Information Available**

Field Shelterbelts for Soil Conservation, Agdex 277/20-3
Shelterbelt Story - video (19 minutes).

D. **Suggested Field Demonstrations**

Planting new shelterbelts

Highway regulations stipulate that shelterbelts must be 30 metres from the limit of the highway (fence line). Since protection is afforded both sides of a shelterbelt, planting at 30 metres from the fence on both the north and west sides would allow farming on both sides and make maintenance easier. Shelterbelts that lie north and south, spaced at 20 times the height of the shelterbelt, give protection and would make the best demonstration shelterbelts.

To be most effective the shelterbelts should have a porosity of about 40 percent. This is achieved by green ash or Siberian larch at five feet (1.5m) apart, eight feet (2.5m) for poplars or 18" (50 cm) for caragana, requiring per quarter section about:

- 15,000 caragana
- 2,000 green ash or Siberian larch
- 1,250 Northwest poplar

The plants must be watered in as soon as possible after planting, and at least weekly for the next three or four weeks if there is no rain. Trifluralin could be incorporated into the row prior to planting for weed control most of the first year, and Linuron may be fall applied one year after establishment. All failed plants must be replaced to ensure a solid shelterbelt. Gaps in the shelterbelt drastically reduce the effectiveness of the shelterbelt.

E. Suggested Applied Research

a) On new shelterbelts:

Height and spread of new shelterbelts after one, five, ten and twenty years are needed to establish growth rates across the province.

b) On shelterbelts five years old and older:

Crop yields per square metre or per standard length of swath at 1,2,5,10,15 and 30 times the height of the shelterbelt perpendicular to the leeward side and at 1 and 2 x height on the windward side, would give an indication of the effect on crop yield. Additional observations, such as snow depth, moisture content of the soil at planting time, the survival of fall rye or winter wheat and of forage or special crops, and the amount of soil movement is desirable.

Accurate records are necessary for an overall assessment of shelterbelts. The shelterbelt specialist should be involved in planning and receive copies of local records in order to determine the effects across the province.

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